Govt. of Bihar
MUZAFFARPUR INSTITUTE OF TECHNOLOGY, MUZAFFARPUR, BIHAR – 842003

(Under the department of Science & Technology, Bihar, Patna)

B.Tech 7th Semester Mid-Term Examination, 2018
DESIGN OF HYDRAULIC STRUCTURES

Time: 2 hours **Full Marks: 20**
Subject Code: 011X25

Attempt any four questions.

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1. List out the various classifications of canal based on

Answers :

(a) **Nature of source of supply**

- Permanent canal (continuous source of water supply)
- Inundation canal (Draws its supplies from a river only during high stage of the river)

(b) **Function of canal**

- Irrigation canal
- Power canal
- Feeder canal
- Navigation canal

(c) **Boundary surface of the canal**

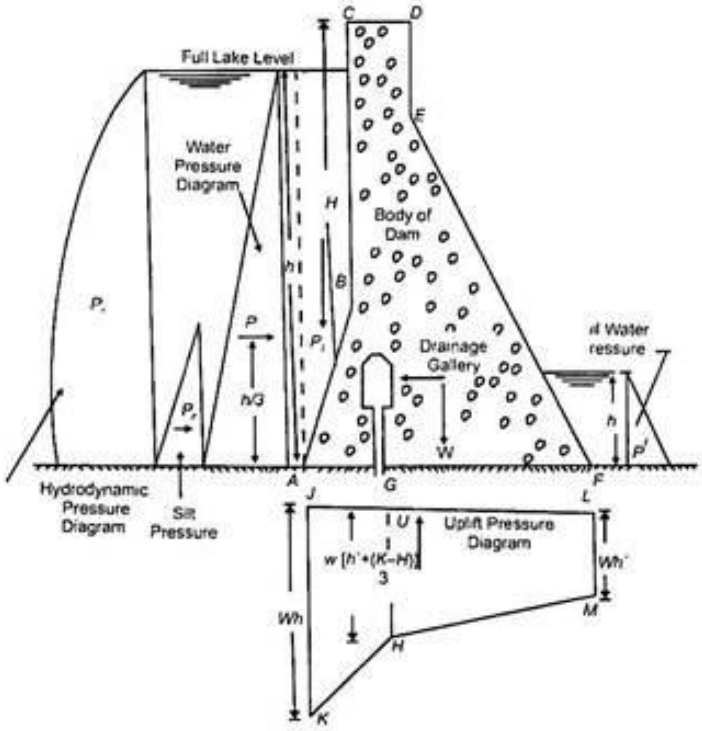
- Unlined canal
- Lined canal

2. What are the forces which are subjected on the Gravity Dam? Represent the forces with Pressure diagram.

Answer:

A gravity dam is a dam constructed from concrete or stone masonry and designed to hold back water by primarily using the weight of the material alone to resist the horizontal pressure of water pushing against it. All the predominant forces (external forces) that act on the dam are:

(i) water pressure or Horizontal hydrostatic pressure due to water (ii) weight of the dam (iii) Uplift pressure due to water percolated under the dam (iv) silt pressure (v) wave pressure (vi) Ice pressure (vii) Pressure due to Earthquake force (viii) Wind pressure (ix) Hydrodynamic pressure



3. Write short notes on

(a) Maintenance of Irrigation canal and

Answer: The performance of an irrigation canal system depends not only on how the system is operated, but also on the condition of the canals. Irrigation canals function well so long as they are kept clean and if they are not leaking. If no attention is paid to the canal system, plants may grow and the problem of siltation may arise. Even worse, the canals may suffer from leakages. It is not just the smaller, tertiary irrigation canals that need to be maintained, it is the primary and secondary canals as well. A good maintenance Programme can prolong the life of canals. A routine, thorough Programme should be kept to. Maintenance of an irrigation canal system is usually carried out in between two irrigation seasons, or at times of low water demand. It consists of cleaning, weeding, desilting, re-shaping, and executing minor repairs.

Following points should be keep in the mind while maintaining the canal

(i) Bushes or trees on canal embankments should be removed. They may obstruct the water flow and their roots will open the compacted soil in the banks and cause the development of leakages.

(ii) Plants, silt and debris in the canal should be removed. While cleaning the canal bed, care must be taken that the original shape of the cross-section is kept. For this, a wooden frame, or template, with the exact dimensions of the designed cross-section of the canal being cleaned, can be of great help.

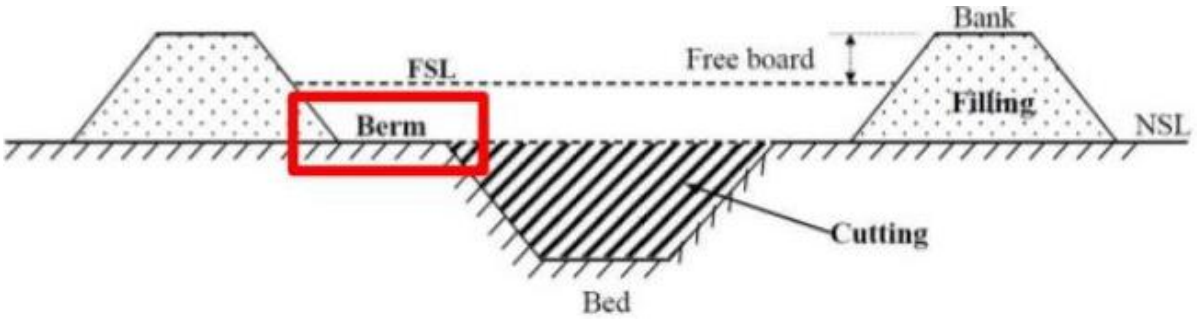
(iii) Breaches and rat holes in the embankments should be filled with compacted soil, inside as well as outside of the embankment. For compacting, the soil should be wetted.

(iv) Weak sections and sections of canal embankments where people or animals cross the canal should be strengthened with compacted soil or with bricks.

(v) Eroded sections of a canal should be rebuilt to the original shape.

(b) Purpose of Berm

Answer: Berm is the horizontal distance left at ground level between the toe of the bank and the top of the edge of cutting. See figure also.



There are following purpose of Berm:

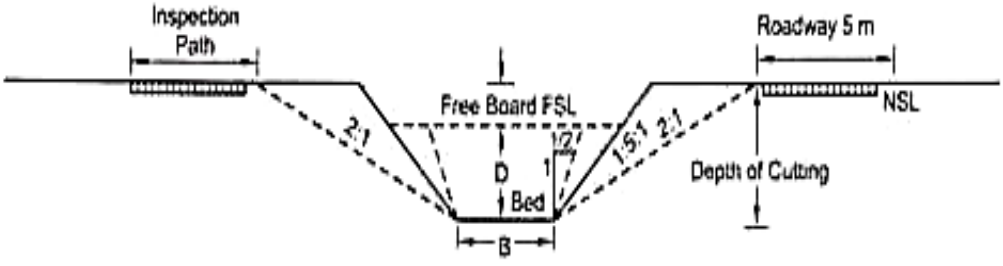
(i) They give additional strength to the banks and provide protection against erosion and breaches.

(ii) They protect the banks from erosion due to wave action.

(iii) They provide a scope for future widening of the canal.

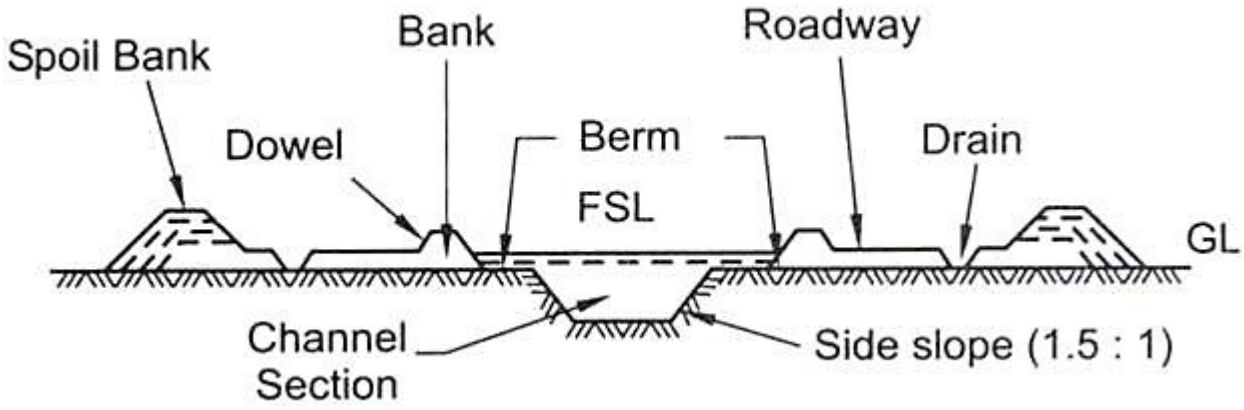
4. Draw typical canal section in full cutting with neat and clean sketches with terminology.

Answer: Longitudinal section of canal in full cutting as shown in figure.



Terms used in longitudinal section in canal

Spoil bank, Dowel, Berm
Free Board, FSL (Full Supply Level)
Service Road, Roadway, Bank



Typical cross-section of canal showing component parts

5. What do you understand by "Balancing Depth"? Derive an expression for the same as Where,

y = depth of cutting, b = bed width of the channel,

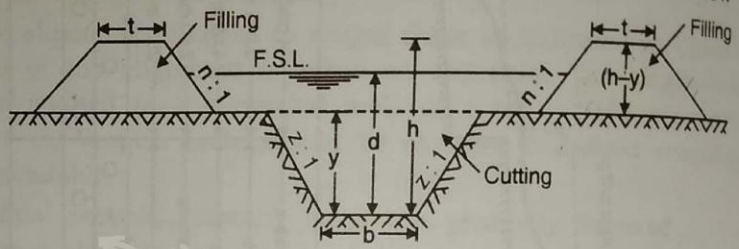
h = vertical height of top of bank from bed of canal, t = top width of canal bank

$$y2 - \left(\frac{b}{2} + 3h + t\right)y + h\left(t + \frac{3}{2}h\right) = 0$$

Answer: Balancing canal depth comes when the canal is in partially embankment and partially in cutting.It is the depth of the canal which gives equal amount of filling (i.e earth required for formation of Banks) and cutting (i.e earth from digging). For a given cross-section of a canal, it has only one balancing depth. For this depth the canal sectional will be economical.

Derivation:

A canal section will be economical when the earth work involved at a particular section has an equal amount of cut and fill. Usually a canal section has a part in cutting and part in filling as shown in Fig. If the amount of cut is equal to the amount of fill, it has to be paid for once only. More so, the necessity of a borrow pit or soil bank is entirely avoided. For a given cross-section there is always only one depth of cutting for which the cutting and filling will be equal. The depth is known as *balancing depth*. The balancing depth is worked out as under :



BALANCING DEPTH.

If h = vertical height of top of bank from bed of canal.
b = bed width of the channel.
t = top width of the canal bank.
$n : 1$ = side slope of bank in filling.
$z : 1$ = side slope of canal in cutting.
d = full supply depth of the channel.
y = depth of cutting

$$\text{Area of the cut} = by + zy^2 = y(b + zy)$$

$$\text{Area of fill} = 2[(h - y)t + n(h - y)^2].$$

Equating the area of cut and fill

$$y(b + zy) = 2[(h - y)t + n(h - y)^2]$$

or $$y^2(2n - z) - (b + 4nh + 2t)y + h(2t + 2nh) = 0$$

A canal is usually constructed with a side slope of 1 : 1 in cutting and a slope 1.5 : 1 in filling . Therefore, putting $n = 1.5$ and $z = 1$ in Eq. 15.1 we get.

$$y^2 - (b/2 + 3h + t)y + h\left(t + \frac{3}{2}h\right) = 0$$

OR

Calculate the balancing depth for channel section having a bed width of 18 m and side slopes of 1:1 in cutting & 2:1 in filling. The bank embankments are kept 3 m higher than ground level (Berm Level) and crest width of banks is kept 2 m.

Answer: Balancing depth is defined as the depth at which excavation and filling becomes equal. Let d be the balancing depth.

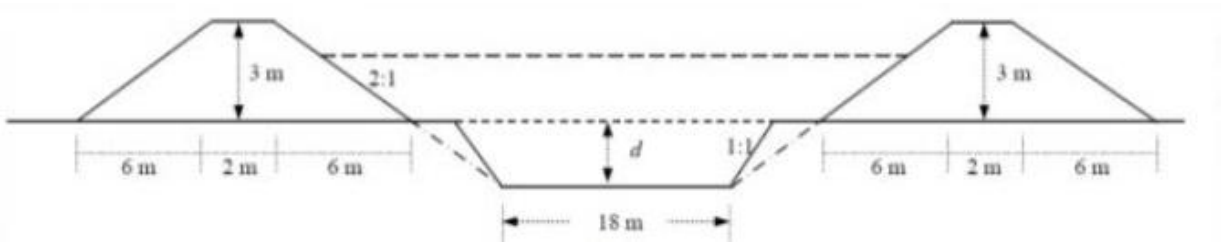


Figure - 1

Area of cutting = $(18 + d)\, d\ m^2$

Area of filling = $2(2+14)/2\times3 = 48\ m^2$

Equating cutting and filling, we get

$(18 + d)\, d = 48$

or, $d^2 + 18d - 48 = 0$

or, $d = 2.35$ *m (neglecting –ve sign)*

Balancing depth = 2.35 m